

## PORTABLE RADIO DEVICE

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention:

5       The present invention relates to a portable radio device, and more particularly to a portable radio device with an information display capability.

#### 2. Description of the Related Art:

10       Various services available on the Internet are in widespread use today. There is a growing need for the users of radio devices, typically portable telephone sets, to connect to the Internet and receive those available services. However, since contents on the Internet are designed and prepared for use by personal  
15       computers having sufficiently large display screen sizes, it is difficult to recognize all the information of those contents with display screen sizes of liquid crystal display panels of portable telephone sets. Therefore, the information of contents displayed by the liquid  
20       crystal display panels of portable telephone sets has suffered various limitations. Those users who want to see information available on the Internet with sufficiently large display screen sizes anywhere at any time can receive the services only with a notebook  
25       personal computer that is connected to a personal digital assistant (PDA) or to a radio device by a cable.

Carrying a notebook personal computer together with a personal digital assistant or a radio device at all times is very inconvenient and troublesome to the user. Therefore, there has been a demand for a portable radio  
5 device which can be carried around with ease and which allows the user to use contents on the Internet with a display screen similar to those of notebook personal computers.

## 10 SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a portable radio device which permits the user to use contents on the Internet with a sufficiently large display screen size without impairing its own  
15 portability.

According to the present invention, there is provided a portable radio device comprising a flat lid having on a surface thereof a concave reflecting member having a predetermined curvature, and a small-size  
20 display device having an information display function for projecting light rays of a displayed image, the lid and the display device being adjustable in their positional relationship for applying light rays of a displayed image projected from the display device to the concave  
25 reflecting member and reflecting the light rays at an enlarged scale from the concave reflecting member.

The portable radio device may further comprise a casing, the flat lid being angularly movably coupled to an end of the casing by a hinge mechanism, the small-size display device being positioned with respect to the lid  
5 such that when the lid is angularly moved and held at a given angle, light rays of a displayed image projected from the display device is applied to the concave reflecting member and reflected at an enlarged scale from the concave reflecting member.

10 The small-size display device may be angularly movably mounted on the casing or the flat lid.

The portable radio device may further comprise a casing and a module casing detachably connected to the casing, the small-size display device being mounted in  
15 the module casing, the flat lid being angularly movably coupled to an end of the module casing by a hinge mechanism. The module casing may have an external interface connector, and the casing may have a connector which electrically connects the casing to the external  
20 interface connector, the module casing being structurally connected to the casing by the connector.

The small-size display device may be angularly movable for positional adjustment.

The portable radio device may be used as a portable  
25 telephone set.

With the above arrangement of the present invention, the portable radio device has the flat lid angularly movably coupled to the end of the casing by the hinge mechanism and having a concave mirror as the concave reflecting member, and the small-size display device having the information display function. The portable radio device is based on the principles that when an object is moved closer to the concave mirror than the focal point thereof, the image of the object is enlarged by the reflecting mirror. When the lid is angularly moved and held at a certain angle, light rays of a displayed image projected from the display device are reflected by the concave mirror and recognized as representing an enlarged image by the user. Since the light rays projected from the display device are reflected by the concave mirror and recognized as representing an enlarged image by the user, the portable radio device provides an information display capability which is much better than the information display capability of a conventional LCD display screen size, though the display device may be a small-size LCD, for example.

The above and other objects, features, and advantages of the present invention will become apparent from the following description based on the accompanying

drawings which illustrate an example of a preferred embodiment of the present invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5        Fig. 1 is a perspective view of a portable radio device with an upper device portion thereof being open, according to a first embodiment of the present invention;

      Fig. 2 is a side elevational view of the portable radio device shown in Fig. 1 with a lid being open;

10       Fig. 3 is an enlarged cross-sectional view taken along line III - III of Fig. 1, showing a portion of the lid near its hinged end;

      Fig. 4 is a view showing the manner in which the user uses the portable radio device according to the  
15 first embodiment of the present invention;

      Fig. 5 is a perspective view of a portable radio device with an upper device portion thereof being open, according to a second embodiment of the present invention;

20       Fig. 6 is an enlarged cross-sectional view taken along line VI - VI of Fig. 5, showing a portion of a lid near its hinged end with the lid being open;

      Fig. 7 is a perspective view of a portable radio device with an upper device portion thereof being open,  
25 according to a third embodiment of the present invention,

showing the manner in which a module is attached to the portable radio device; and

Fig. 8 is a fragmentary side elevational view of a lower device portion of the portable radio device shown in Fig. 7 and a module casing as it is connected to the lower device portion.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A portable radio device according to a first embodiment of the present invention will be described below with reference to Figs. 1 through 4.

In the first embodiment, the portable radio device comprises a portable telephone set, and a display device thereof comprises an LCD panel.

As shown in Figs. 1 and 2, the portable radio device comprises lid 1, lower device portion 6, and upper device portion 12. Lid 1 is angularly movably mounted on lower device portion 6 by joint 1a, and can be folded over lower device portion 6. Upper device portion 12 is angularly connected to lower device portion 6 by hinge 7, and can be folded over lower device portion 6 and lid 1 that has been folded over lower device portion 6.

As shown in Fig. 3, lid 1 has concave reflecting mirror 1b disposed on the reverse side thereof and engaged by inner contact surface casing 1d. As shown in Fig. 2, lower device portion 6 includes projection LCD 2

disposed on a surface thereof for projecting an image onto concave reflecting mirror 1b when lid 1 is opened.

According to a feature of the present invention, the portable radio device has, on one end of its housing, flat lid 1 angularly mounted on the end of the housing by joint 1a of a hinge mechanism and having concave reflecting mirror 1b on one surface thereof, and small-size projection LCD 2 having an information display function. When lid 1 is angularly moved and held at a certain angle, light rays projected from projection LCD 2 are enlarged to a large scale by concave reflecting mirror 1b and visually recognized by the user of the portable radio device. As shown in Fig. 2, light rays having width  $X_1$  which are projected from projection LCD 2 are enlarged to a large scale by concave reflecting mirror 1b on one surface of lid 1, and visually recognized as having width  $X_2$  by the user. Though projection LCD 3 is of a small size, the portable radio device provides an information display capability which is much better than the information display capability of a conventional LCD display screen size.

The structure of portable radio device according to the first embodiment as it is applied to a foldable portable telephone set will be described in greater detail below with reference to Figs. 1 through 4. The portable telephone set has upper device portion 12 and

lower device portion 6. Upper device portion 12 primarily has antenna 11, LCD 10 for indicating incoming calls, receiver 8 for producing sounds based on radio signals that have been transmitted, LCD 5 for displaying various pieces of information, and a built-in electric circuit which electrically interconnects those components and has predetermined functions. Lower device portion 6 primarily has battery pack 17 for supplying electric energy, control buttons 18 for entering information, I/O connector 4 for connection to an external interface, projection LCD 2 which is smaller in size than LCD 5 of upper device portion 12 and inclined at a certain angle, and a built-in electric circuit which electrically interconnects those components and has predetermined functions. Upper device portion 12 and lower device portion 6 are coupled to each other by hinge 7 such that when they are closed, i.e., folded over each other, the surface of upper device portion 12 which has LCD 5 and the surface of the lower device portion 6 which has control button 18 are substantially held in contact with each other, and when are opened, i.e., unfolded away from each other, the surface of upper device portion 12 which has LCD 5 and the surface of the lower device portion 6 which has control buttons 18 are angularly spaced from each other by a certain angle.



The portable telephone set also has lid 1 angularly movably coupled to the end of lower device portion 6 by joint 1a. Lid 1 has its face lying flush with the surface of lower device portion 6 which has control buttons 18 when lid 1 is closed on lower device portion 6. Lid 1 has on its face buttons 3 and sound hole 9 associated with a microphone for detecting voice sounds. The microphone may be installed in lower device portion 6 or lid 1. As shown in Fig. 3, each of buttons 3 is attached to lid 1 by base 3b in the form of a thin plate, and has concave surface 3a and projection 3c for operational purpose. When concave surface 3a is pressed, metal dome 13 mounted on printed circuit board 14 is depressed, transmitting an entered signal via flexible printed board 15 to lower device portion 6. Flexible printed board 15 extends through joint 1a into lower device portion 6. Concave reflecting mirror 1b, which has a certain size and curvature, is mounted on an inner surface of lid 1 for contact with lower device portion 6, and integrally fixed to lid 1 by fitting or bonded engagement. Rather than using concave reflecting mirror 1b, a portion of inner contact surface casing 1d may be of a shape which is the same as the concave reflecting mirror, and processed into a mirror surface as by evaporation. Therefore, the number of the components may be cut down.

5 The portable telephone set thus constructed is used  
as follows: When in use, the portable telephone set is  
unfolded as shown in Fig. 2. Specifically, upper device  
portion 12 is angularly moved and held at a certain angle  
with respect to lower device portion 6. Then, lid 1 is  
angularly moved and held at a certain angle with respect  
to lower device portion 6. Light rays 2a projected from  
projection LCD 2 are reflected as light rays 2b by  
concave reflecting mirror 1b on the inner contact surface  
of lid 1. Concave reflecting mirror 1b has a curvature  
such that the width  $X_1$  of the display screen of  
projection LCD 2 is much smaller than the width  $X_2$  of the  
reflected image. Therefore, the eyes of the user  
visually recognize the display screen size of projection  
LCD 2 as a much larger display screen size as shown in  
Fig. 4. With this arrangement, the portable radio device  
permits the user to use contents on the Internet with a  
sufficiently large display screen size without impairing  
the portability of its own.

20 Ordinary portable telephone sets do not need to  
have a large LCD as LCD 5 which is only its display  
means, but may have a LCD of a required minimum size for  
satisfying desired requirements. In extreme cases,  
ordinary portable telephone sets may not have any LCD.  
25 Recently, there has been discussion about providing  
portable telephone sets with large color LCDs. However,

color LCDs require consumption of a greater amount of electric energy as their size increases. Since portable telephone sets should be lightweight and small in size, it is difficult for them to incorporate a large-capacity battery in view of the weight and size of the battery. According to the present invention, inasmuch as a small color LCD is sufficient, it is possible to provide a portable telephone set which is able to reduce any increase in its power consumption and which is lightweight and small in size.

In the first embodiment, projection LCD 2 is fixed in place. However, projection LCD 2 may also be angularly movable, so that when the user turns lid 1 to any desired angle, projection LCD 2 may also be turned to project an enlarged reflected image toward the eyes of the user. Therefore, projection LCD 2 that is angularly movable makes the portable telephone set highly flexible to meet different face sizes of users and different individual ways in which different users hold the portable telephone set.

The portable radio device according to the first embodiment has been described as being applied to a portable telephone set. However, the principles of the present invention are also applicable to a wide range of portable radio devices. In addition, the display device is not limited to an LCD panel.

A portable radio device according to a second embodiment will be described below with reference to Figs. 5 and 6. The portable radio device will be described below as a portable telephone set.

5        In the first embodiment, projection LCD 2 is mounted in lower device portion 6. According to the second embodiment, projection LCD 22 is mounted in lid 21. Other structural details of the portable radio device according to the second embodiment are identical  
10 to those of the portable radio device according to the first embodiment, and will not be described in detail below.

Structural details of projection LCD 22 will be described below with reference to Fig. 6. Projection LCD  
15 22, which is of a small size, is disposed in confronting relation to concave reflecting mirror 21b at a certain angle such that projection LCD 22 projects light rays in a suitable direction toward concave reflecting mirror 21b when in use. Concave reflecting mirror 21b has such a  
20 curvature as to greatly enlarge the display screen size of projection LCD 22 as recognized by the user, as with the first embodiment. Since concave reflecting mirror 21b and projection LCD 22 are disposed on lid 21 as described above, they can initially be integrally  
25 constructed in an optimum positional relationship and layout. Inasmuch as lid 21 is angularly movably mounted

on lower device portion 26 by joint 21a, when the user turns lid 21 to any desired angle, an enlarged reflected image can be projected toward the eyes of the user. Therefore, the portable telephone set is highly flexible to meet different face sizes of users and different individual ways in which different users hold the portable telephone set. Lid 21 houses therein I/O connector 24 for connection to an external interface and protective cover 20 thereof which are disposed between an end of lid 21 and joint 21a. Lid 21 also houses therein flexible printed board 28 which electrically connects printed circuit board 27 with I/O connector 24 thereon to projection LCD 22, and flexible printed board 29 which electrically connects printed circuit board 27 to lower device portion 26 via joint 21a.

A portable radio device according to a third embodiment will be described below with reference to Figs. 7 and 8. The portable radio device will be described below as a portable telephone set.

In the first embodiment, projection LCD 2 is mounted in lower device portion 6. In the second embodiment, projection LCD 22 is mounted in lid 21. According to the third embodiment, projection LCD 32 and concave reflecting mirror 31b are incorporated in a detachable display extension module. Other structural details of the portable radio device according to the

third embodiment are identical to those of the portable radio device according to the first embodiment, and will not be described in detail below.

Structural details of the display extension module will be described below with reference to Figs. 7 and 8. The display extension module comprises module casing 30 substantially in the form of a box and thin flat lid 31 angularly coupled to module casing 30 by a joint 31a. Module casing 30 houses therein projection LCD 32 obliquely fixed at a certain angle. Lid 31 has concave reflecting mirror 31b which has a curvature such that reflects light rays projected from an image displayed by projection LCD 32 as an enlarged image to a desired position. A connector 35 projecting from module casing 30 is electrically and physically connected to I/O connector 34 on an end of lower device portion 36 of the portable telephone set. When lid 31 is closed, as shown in Fig. 8, it is folded so as to be neatly integrally combined with module casing 30 and hence mounted compactly on module casing 30. With the above arrangement, the user can connect the display extension module to and remove it from the portable telephone set as required, and hence finds it easy to use the display extension module. The display extension module can be handled as an independent optional unit. By making the connectors as standardized components, the display

extension module can be used with a wide range of general portable telephone sets and hence makes itself highly versatile.

As described above, the portable radio device  
5 according to the present invention has a flat lid  
angularly movable coupled by a hinge mechanism and having  
a concave reflecting mirror on its surface, and a small-  
size projection display device having an information  
display capability, the lid and the projection display  
10 device being mounted on an end of a casing. When the lid  
is angularly moved and held at a certain angle, light  
rays projected from an image displayed on the projection  
display device are reflected by the concave reflecting  
mirror and recognized as representing an enlarged image  
15 by the user. Thus, though the projection LCD is of a  
small size, the portable radio device provides an  
information display capability which is much better than  
the information display capability of a conventional LCD  
display screen size.

20 If both the concave reflecting mirror and the  
projection display device are mounted on the lid, then  
light rays projected from an image displayed on the  
projection display device are reflected by the concave  
reflecting mirror on the lid and recognized as  
25 representing an enlarged image by the user in a wide  
range of angular movement of the lid.

If the projection display device is angularly movable, then light rays projected from an image displayed on the projection display device are reflected by the concave reflecting mirror on the lid and  
5 recognized as representing an enlarged image by the user in a wide range of angular movement of the lid.

Since the projection display device is of a small size, the power consumption of the portable radio device can be reduced. Such an advantage manifests itself  
10 particularly when the projection display device is a color display device.

It is to be understood, however, that although the characteristics and advantages of the present invention have been set forth in the foregoing description, the  
15 disclosure is illustrative only, and changes can be made in the arrangement of the parts within the scope of the appended claims.